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EVALUATION OF THE SPHERICAL NEAR FIELD RANGE AT THE TECHNICAL UNIVERSITY OF DENMARK *)

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Introduction. In order to validate claimed accuracies for antenna measurements on the spherical near field test range at the Technical University of Denmark (TUD), a systematic program of measurements was carried out during which the many parameters in the system were varied and their effects investigated. The antenna was an 34 by 19 wavelength elliptical offset fed reflector producing a shaped beam as seen in figure 1. The antenna was nominally linearly polarized.

Measurements and parameters. It was wished to ascertain if the various measurement parameters had any effects on the final results of a spherical near field measurement transformed to the far field. The effects were monitored with respect to:

- Gain in a given (θ, ϕ) direction
- Directivity in a given (θ, ϕ) direction
- First sidelobe levels
- Cross polar levels
- Antenna polarization consistency
- Amplitude phase relationship between the two near field receiving channels.

The parameters which were altered systematically to enable the investigations included:

- Scanning speed
- Measurement distance
- Scan type (polar or azimuthal)
- Location of the test antenna in the measurement sphere.

By changing these parameters, it was hoped to see the effects of for example:

- Multiple reflections
- Room effects
- Receiver linearity and noise
- Antenna deformations under scanning
- Mechanical alignment accuracy
- Probe calibration accuracy

Results. The measurement program produced fifty far fields all taken at 12.0000 GHz. This provided a sound basis for the accuracies claimed. Typical far field patterns are presented in

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figure 2 which displays far fields from near field measurements at three distances. Results in summary form are shown in the table below:

T A B L E

measured quantity	direction (θ, ϕ) degrees	value	one sigma accuracy
directivity	(5.3 , 180)	29.89 dBi	± 0.02 dB
"	(5.1 , 0)	29.70 dBi	± 0.04 dB
gain	(5.3 , 180)	29.35 dBi	± 0.09 dB
"	(5.1 , 0)	29.12 dBi	± 0.09 dB
sidelobe level	(12.9, 0)	-31.46 dB	± 0.48 dB
"	(13.1, 180)	-34.83 dB	± 0.79 dB
"	(7.6 , 90)	-20.22 dB	± 0.12 dB
cross polar level maximum in $\phi = 0^\circ/180^\circ$ plane	(3.5 , 180)	-20.82 dB	± 0.22 dB

TUD spherical near field test facility accuracies as evaluated from fifty measurements made at 12.0000 GHZ on a 34 by 19 wavelength elliptical offset reflector antenna.

As the system at TUD measures two orthogonal field components simultaneously, accurate far field results require knowledge of the amplitude phase relationship between the two measuring ports as well as their polarization characteristics. From the measurements, it was seen that the amplitude ratio could be determined within ± 0.07 dB, and the phase between them was determined to within $\pm 0.6^\circ$. Probe polarization was determined with an accuracy of ± 2 dB for a 50 dB axial ratio as well as a tilt angle accuracy of $\pm 0.2^\circ$.

Conclusion. The accuracy of the TUD spherical near field test range has been studied through the measurement and subsequent near field to far field transformation of the radiation from an 34 by 19 wavelength elliptical contoured beam antenna.

A series of fifty measurements where single parameters were varied in a systematical manner enabled the one sigma accuracies for directivity, gain, sidelobe level and cross polar maximum at 12.0000 GHz to be determined.

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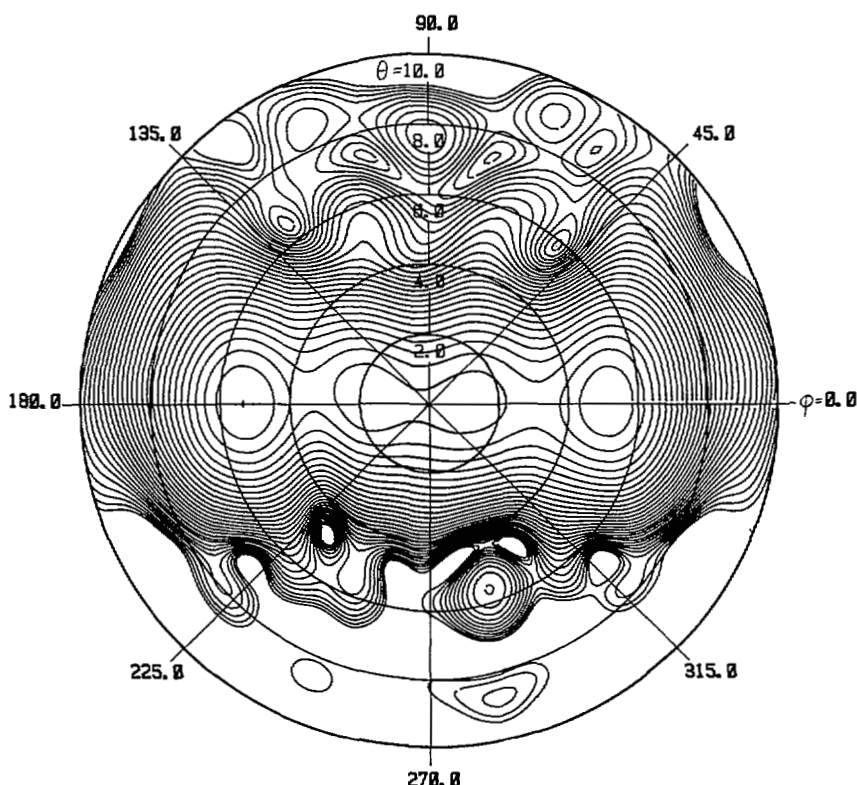


Figure 1. Co polar contour plot in 1 dB steps for $\theta = 0^\circ$ to 10° and $\phi = 0^\circ$ to 360° . Maximum at $(\theta, \phi) = (5.3^\circ, 180^\circ)$.

